REMARKS

Claims 1-3 and 6 were pending in the application. In the Office Action mailed April 13, 2009, claims 1-3 and 6 are rejected. In the instant Amendment, claim 6 has been cancelled, without prejudice; claim 1 has been amended; and claims 18-21 have been added. Claim 1 has been amended to incorporate the limitations of the now cancelled claim 6 and to recite that the claimed stainless steel foil is for an electrically insulating substrate material. Support for the amendment to claim 1 is found in the specification at p. 8, ll. 16-23. Support for new claims 18-19 is found in the specification at p. 13, ll. 12-28. Support for new claims 20-21 is found in the specification at p. 8, l. 32 though p. 9, l. 11. Upon entry of the instant Amendment, claims 1-3 and 18-21 will be pending in the application.

No new matter has been added by the amendment. Entry of the foregoing amendment and consideration of the following remarks are respectfully requested.

Rejections Under 35 U.S.C. § 103

Claims 1-2 are rejected under 35 U.S.C. § 103(a) as being unpatentable over JP Pub. No. 2000-349312 to Tezuka et al. (JP'312) in view of either JP Publication No. 07-213995 to Katayama et al (JP'995) or USP Pub. No. 2002/10156180 to Yamada et al. (US'180). Applicants respectfully submit that claim 1 has been amended to incorporate the limitations of claim 6. These rejections are therefore moot.

Claims 3 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over JP Pub. No. 2000-349312 to Tezuka et al. (JP'312) in view of either JP Pub. No. 07-213995 to Katayama et al (JP'995) or USP Pub. No. 2002/10156180 to Yamada et al. (US'180), and further in view of JP Pub. No 11-269657 to Kamiya et al. (JP'657). Since claim 3 depends from claim 1, which has been amended to incorporate the limitations of claim 6, the rejection of claim 3 is therefore moot.

The present invention is directed to an inorganic-organic hybrid film-coated stainless steel foil in which the inorganic-organic hybrid film has a skeleton formed of an inorganic three-dimensional network structure mainly comprising a siloxane bond, with at least one crosslinked oxygen of said skeleton being replaced by an organic group and/or a hydrogen atom, and serves as an insulating film on the surface of a stainless steel foil, so that the stainless steel foil can be utilized as an electrically insulating substrate material in the

electric and electronics industries.

The applicants have discovered that the control of the [H] concentration relative to the [Si] concentration to provide a [H]/[Si] ratio from 0.3 to 10 provide a desirable inorganic-organic hybrid film, which permits the use of a stainless steel foil as an insulating substrate in the electric and electronics fields. Specifically, the inorganic-organic hybrid film is excellent in cracking resistance, high hardness, heat resistance, adhesion and insulating property, as well as the virtue of good flexibility. See, the specification at p. 10, ll. 22-32.

Furthermore, Applicants have discovered that in addition to the above compositional requirement for the inorganic-organic hybrid film, the thickness of the film Tf realtive to *i*) the roughness of the foil substrate Ras and *ii*) the thickness of the steel foil Ts also affect the characteristics of coated steel foil. In order for satisfactory use of the stainless steel foil as an insulating substrate in the electronics industry, the surface of the substrate on which devices are mounted should be smooth. Applicants found that to obtain a desired surface for the coated stainless steel foil, the thickness Tf of the hybrid film in relation to the roughness Ras of the stainless steel foil is $Ras \leq Tf/2$, preferably $Ras \leq Tf/10$, and more preferably $Ras \leq Tf/20$. See the specification at p. 13, ll. 12-28. The thickness Tf of the hybrid film should be in a range of 0.5 to 2 μm (i.e., $0.5 \mu m \leq Tf \leq 2 \mu m$). A lower Tf may cause a decrease in insulation, while a higher Tf may produce cracks. See the specification at p. 12, ll. 13-26. Among the range $0.5\ \mu m \leq Tf \leq 2 \mu m$, when the thickness Tf of the hybrid film in relation to the thickness Ts of the stainless steel foil is 1/40 or less, i.e., $Tf \leq Ts/40$, the deformation of the insulating stainless steel foil substrate, resulting from the shrinkage of the hybrid film during the film formation, is suppressed. See, the specification at p. 12, ll. 13-26 and p. 13, ll. 7-10. The specification also discloses that the thickness of the stainless steel foil Ts should be less than 100 **μ**m, and preferably 10 to 100 **μ**m. See the specification at p. 8, l. 32 though p. 9, l. 11.

In contrast, JP'312 is concerned with improving the reliability of a solar battery wherein the main component of the insulating layer is silicon oxide. JP'312 discloses a stainless steel substrate of a solar cell with a thickness of 20-150 μm (¶ [0021]) coated with an insulating layer (a polysiloxane film) with a thickness of 0.1 nm-5 μm (¶ [0025]). JP'312 is silent regarding a cross linked oxygen silane bond being replaced by an organic group having a ratio of hydrogen and silicon, i.e. [H]/[Si], from 0.3 to 10. JP'312 also does not teach or suggest the claimed combination of thickness of the film Tf, thickness Ts of the

stainless steel foil substrate, the roughness of the foil substrate Ras and the roughness of the hybrid film Raf, and its effects on cracking resistance, hardness, heat resistance, adhesion and insulating property, as well as flexibility. For example, JP'312 is silent regarding the roughness of the film and the substrate. JP'312 teaches a film thickness of 0.1 nm-5 μm, which encompasses films that are, according to the present invention, too thin to provide sufficient insulation, as well as films that, according to the present invention, are too thick to avoid cracking. Further, JP'312 does not teach or suggest that $Tf \leq Ts/40$ is important to avoid deformation of the coated stainless steel foil. Based on the ranges of film thickness and substrate thickness disclosed by JP'312, JP'312 encompasses a Tf as thick as Ts/4 (which corresponds to a film thickness of 5 μm and a substrate thickness of 20 μm).

With respect to the ratio of hydrogen and silicon in film having a cross linked oxygen silane bond being replaced by an organic group, the Examiner cites to JP'995 and US'180 for teaching these elements.

JP'995 concerns a thick steel board or plate for use in buildings, marine vessels, machinery, cars, and consumer goods, coated with an inorganic-organic composite material in which the inorganic polymer network of M-O-M bond is substituted by an O-$Si(R)_2$-O group, and also discloses the molar ratio of organic component, i.e., alkyl bearing silane/inorganic component, i.e., the alkoxide, being in a range of 8.0 to 0.1 for the inorganic-organic composite material.

US'180 discloses a low dielectric film for coating a Si wafer (see, US'180, Examples) having a three-dimensional network structure containing a siloxane skeleton wherein some or all of the SiO_4 tetrahedron units are replaced with organic groups, and also discloses the molar ratio of Si directly bonded to hydrogen with respect the total Si is 0.3 or greater for the low dielectric film.

Thus, regardless of what JP'995 and US'180 teach about the composition of the film, JP'995 and US'180 fail to teach or suggest a coated stainless steel foil substrate, or the claimed combination of thickness of the film Tf, the thickness of the stainless steel foil Ts, the roughness of the foil substrate Ras, and the roughness of the hybrid film Raf, much less its cracking resistance, hardness, heat resistance, adhesion and insulating property, as well as flexibility and flatness.

The Examiner contends that JP'657 teaches an inorganic-organic hybrid

functional film having a roughness of 0.5nm or less (JP'657 ¶ [0033]) and that it would have been obvious to one of ordinary skill in the art at the time of the invention to modify JP'312 hybrid film with the roughness taught by JP'657.

JP'657 is concerned with a water repellant, low friction film with a small surface roughness, obtained by providing a base silica membrane on a hydroxyl bearing substrate, such as glass, ceramic, metal or plastic. The membrane is then treated to form a surface organic layer (JP'657 ¶ [0032]). The thickness of the above silica film is limited to the range of 5-300 nm (JP'657, ¶ [0019]), which is thinner than permitted by the range of the present invention. Such a thin film is not a satisfactory insulating film. The thickness of the hydrophobic coating on the silica film is also thin, thinner than the silica film since the hydrophobic coating is a molecular layer of alkyl groups chemically bonded to the surface of silica film (JP'657, ¶¶ [0053], [0055]).

Although JP'657 teaches a thin film of low surface roughness, it does not teach or suggest that a thicker film, such as that of the present invention, would also have a low surface roughness. As discovered by the Applicants, a thicker film may cause deformation of the stainless steel foil substrate if its thickness Tf in relation to the thickness of the stainless steel foil Ts is not controlled to, e.g., 1/40 or less, i.e., Tf≤Ts/40. This indicates that a thicker film such that of claimed in the present application may have properties and/or problems that a thin film such as that of JP'657 does not have. JP'657 does not teach or suggest such properties or problems associated with the film of the present invention. JP'657 does not teach or suggest the claimed combination of thickness of the film Tf, thickness Ts of the stainless steel foil substrate. JP'657 does not teach or suggest the roughness of the foil substrate Ras and the thickness of the hybrid film Tf, and its effects on cracking resistance, hardness, heat resistance, adhesion and insulating property, as well as flexibility and flatness. Therefore, regardless of what JP'657 teaches about the roughness of its thin silica film and the hydrophobic coating, JP'657 does not supply what are missing in JP'312, JP'995, and US'180.

Therefore, the inorganic-organic hybrid film coated stainless steel foil according to the present invention differs both in structure and function from JP'312, JP'995, US'180 and JP'657, either individually, or in combination. For at least the above reasons, the rejection of claims 1-3, as amended, under 35 U.S.C. §103(a) as being obvious over JP'312, JP'995, US'180 and JP'657 should be withdrawn.

It is submitted that in view of the present amendment and foregoing remarks, the application is now in condition for allowance. It is therefore respectfully requested that the application, as amended, be allowed and passed to issue.

Respectfully submitted,

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